

Multicloud Networking and NaaS Survey Report

October 2023



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Highlights and Key Findings

- **We conducted our 2023 survey on multicloud networking (MCN) and network-as-a-service (NaaS) in September and October.** The survey of 125 qualified IT and networking professionals indicates a critical need for MCN and NaaS technology to enable a broad range of cloud services and access.
- **A majority of respondents in networking and IT roles (90%) said there is a “critical” or “very important” need for MCN connectivity.** These technology platforms and services will help build secure, virtualized networking across enterprise datacenter, edge, service provider, and public cloud services.
- **Networking and MCN is needed for hybrid and multicloud environments.** A large majority of survey respondents (78%) believe MCN will help simplify or accelerate hybrid cloud and multicloud adoption.
- **The top ROI metrics for MCN include improved applications performance (selected by 37%), speed and agility in deploying applications (28%), and cost savings (26%).** The results show a balanced need across those top three.
- **Managing applications across clouds is crucial.** In addition to seeking better multicloud applications performance, end users see MCN as playing a critical role in managing applications policy and security across clouds.
- **Network operators would like to integrate cloud, service provider, and enterprise networking resources.** Forty-one percent of survey takers said they would like to integrate traditional networking infrastructure with networking from public cloud services. Also, 59% of respondents said it’s important to have MCN connectivity among datacenter, edge, telecommunications provider, and public cloud services.
- **AI, 5G, and edge applications are big drivers of MCN.** A majority of respondents (66%) expect the arrival of services such as 5G networks, edge compute, and private wireless to increase their need for MCN solutions.
- **Investment in MCN technology is expected to grow, but at a measured pace.** Seventy-six percent (76%) are expected to make investments in MCN and cloud-native networking.
- **Some of the companies highlighted in this report:** Arrcus, Aviatrix, Amazon (AMZN), Aryaka Networks, Cisco (CSCO), Digital Realty (DLR), Equinix (EQIX), F5 Networks (FFIV), Google (Alphabet - GOOGL), IBM (IBM), Iptential, Juniper Networks (JNPR), Megaport, Microsoft (MSFT), PacketFabric, Proximo, Tata Communications, Versa Networks, VMware (VMW).



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The results are in, and multi-cloud networking is the new normal. But there's good news: even though these architectures are complex, securing them doesn't have to be. F5 Distributed Cloud Services securely connect applications, networks, and Kubernetes clusters across hybrid and multi-cloud environments at scale. Reduce your time-to-market by up to 12x with integrated application and security services.

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Introduction: MCN Is Key to Hybrid Cloud and Multicloud Strategies

It's that time of year. In what has become a Futurium tradition, we have completed our annual end-user survey on multicloud networking (MCN) and network-as-a-service (NaaS) technology and services. The survey data has strengthened our view that networking will come to be regarded as the linchpin to multicloud and hybrid cloud strategies – as all distributed applications and data must be connected by secure, intelligent networks.

For this year's survey, we reached out to hardcore networking, security, and operations teams using a variety of methods, including social promotions, our newsletter, and our website. The annual survey included responses from a total of 125 qualified IT and network managers (more on the survey below). To supplement our knowledge and analysis for this report, we conducted interviews with end users and technology providers.

“Conclusion: Networking will come to be regarded as the linchpin to hybrid cloud strategies.”

For those of you not yet familiar with the MCN trend – which we have called the “Third Wave of Networking” – it's a new requirement among network and cloud architects to be able to securely connect multiple network domains – enterprise, datacenter, cloud, and communications provider -- with a more integrated networking platform. The needs of these cloud networking platforms vary widely (we'll get into that later), but they range from application visibility to network security and policy.

This report will detail the full findings of our research, which can be seen in the “Key Findings” above. Before we dive in, let's cover some key trends in the market:

Trend #1: MCN is about connecting apps across clouds. As organizations move to distributed cloud apps, AI, and cloud native, they need a variety of ways to connect applications and data across cloud – which will require MCN.

Trend #2: MCN is about better integration of network services. The survey results send a

strong signal: Network operators – whether enterprise, cloud, or telco – would like a way to connect and manage diverse network connectivity as if it’s one network.

Trend #3: MCN is about better visibility, compliance, and cost control. The survey results indicate that managers are struggling to manage a fragmented collection of networking silos – they need better data, visibility, and cost controls across all their networks.

A Pivot Toward the Needs of Apps

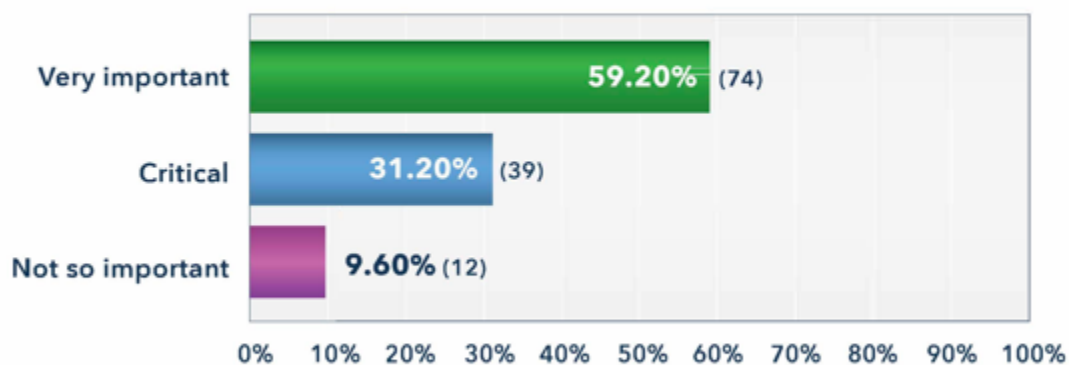
Regardless of the architecture with which they are delivered, enterprise infrastructure and cloud services help enable new applications. The cloud revolution created a new way to build more scalable, distributed apps very quickly using the webscale model.

However, not all applications can be limited to the cloud. Data and technology requirements for specific organizations still require managers to leverage private and on-premises resources. In addition, some apps will always need to run locally – for example, data-intensive edge apps. It’s clear from our survey results that end users see MCN playing a critical role in enabling apps that may have to access data on different platforms.

Better Integration of Network Services

To deliver MCN, network operators need ways to connect multiple cloud infrastructures with a single logical management approach.

How important is it to have seamless multicloud networking (MCN) connectivity among your enterprise datacenter, edge, telecommunications provider, and public cloud services?



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Responses: 125

After years of building separate infrastructure for enterprise campus, datacenter, and communications services, they would like these infrastructure silos to operate as one integrated network.

Fortunately, the advent of cloud services and APIs has given network operators the chance to do that. There's no longer a reason why the service provider network can't connect to the campus network without delivering information and visibility of the data and applications traversing the network. This is the end goal of MCN: delivering application policy, security, and management across all networks as if they were one.

This approach to MCN can deliver gains in security and governance as well, as organizations build a centralized way to gain visibility and policy control over their multicloud and hybrid cloud infrastructure and apps.

About The Report Survey

In this report, we'll dive into more detail about all of these trends, as well as expand the analysis of MCN. Much of our analysis is based on the feedback of 125 end users gathered in a survey.

We ran the survey for several weeks using several targeting methods and promotions and collected 245 total responses, filtering down to 125 by only examining responses from those that affirmed they worked in DevOps, IT, networking, or security.

All of the respondents were anonymous and based in the United States. Some of the respondents voluntarily supplied job titles. Some of the titles of the end users that filled out the survey included: CIO, DevOps Engineer, Data Analyst, Chief Software Architect, IT Manager, Director, VP Technology, Senior Applications Engineer, Cloud Op Engineer, Senior Manager IT, Systems Architect, and Web Developer.

In the next sections, we dive deeper into MCN technologies, drivers, features, and needs – as well as some more general conclusions about the market for MCN based on our survey results and interviews.

MCN Background: How Cloud Needs Change Networking

Before we dive into more survey results, let's take a quick look at the history and evolution of MCN – as well as key definitions.

We've referred to the growing demand for multicloud and hybrid cloud networks as the Third Wave of Networking. The first wave was client/server (1990s). The next wave was datacenter (2000-2020). The Third Wave, which has gotten underway, is MCN and NaaS. Before we dive into the survey results, let's spend some time on the context and technologies that are involved in building MCN and NaaS.

MCN and NaaS technologies can enable faster, programmatic networking connectivity among disparate networking domains. These technologies represent an evolution of software-defined networking (SDN), which evolved to programmatically deliver networking connectivity in datacenters and hyperscale cloud environments. The next step was to use a programmatic, SDN approach to connect enterprise branches to cloud environments or Web applications, using secure virtualized overlays – the software-defined wide-area networking (SD-WAN) movement.

While SD-WAN addresses many needs – such as enterprise branch connectivity and security – a more complete solution is needed to connect all networking domains: enterprise branch, datacenter, telecommunications, and cloud. That need has given birth to MCN and NaaS, which enable enterprise networking environments to build secure, virtualized networking fabrics to connect to any networking environment, across any environment, including enterprise networks, datacenters, public cloud infrastructure, and service provider infrastructure.

Cloud Networking Taxonomy

Before we delve into more research results, let's go through some of the industry taxonomy and nomenclature so it's clear what we are talking about.

As we have described, the distributed nature of the cloud has created networking silos. The easiest way to think of these silos is in at least four major buckets: traditional enterprise networking, datacenter networking, cloud networking, and telecommunications infrastructure. Now that distributed cloud applications have arrived, MCN helps build networks that can more seamlessly cross these borders and keep applications consistently connected.

Connecting diverse networking silos employs many technologies and methods. Here are several of the categories and approaches needed to be considered in building MCNs:

Private cloud and datacenter: A private cloud describes a datacenter built with current cloud technologies that runs “on-premises” or is hosted and managed by an organization or an enterprise itself, rather than in a public cloud.

Public cloud: A public cloud is usually a distributed array of cloud resources and infrastructure run by a large platform-as-a-service (PaaS), infrastructure-as-a-service (IaaS), or software-as-a-service (SaaS) company, providing services to other organizations.

Multicloud: Enterprises might need services or resources from multiple IaaS or PaaS services, such as Amazon Web Services (AWS), Microsoft Azure, or Google Cloud Platform (GCP). In this case they need to connect their networking infrastructure to multiple public cloud infrastructures, all of which have specific requirements.

Hybrid cloud: When enterprises build distributed applications that share resources on both private and public cloud infrastructure, it is referred to as hybrid cloud.

MCN technology: MCN technology provides the capability to build a logical, software-defined, secure network for cloud applications across multiple private clouds, datacenters, and public clouds. This can happen at both the application layer as well as at the network layer – but preferably it should happen in both.

Service provider infrastructure and NaaS: Service providers – including communications service providers, cloud providers, and datacenter providers – supply global infrastructure and networking services to connect regions, points of presence (PoPs), and communications services such as 5G or networking. NaaS is a model in which networking or communications services can be purchased on demand, for example using dedicated Internet access (DIA) or Ethernet services to connect datacenter PoPs or public cloud onramps.

Cloud Apps Drive Building Blocks for Hybrid Cloud and MCN

The next question might be: How do we build MCN? The simple answer is that MCN is built using software that provides virtualized networking services between any cloud service or infrastructure. It's all about using a programmatic software connection among the network silos, driven by automation.

That’s evolving over time, but the key driver is distributed applications that reside in different parts of the infrastructure and require software-based connectivity. MCN and NaaS are enabled by some fundamental technologies that help connect integrated cloud networks, as described below:

Application programming interfaces (APIs): APIs have been a crucial element of datacenter and SD-WAN virtualization, and they will become increasingly important to connect MCN. APIs enable hardware or software to expose connectivity and configuration information in the form of code, enabling automation. Data APIs can be used to provide a steady stream of network telemetry and

state information. The use of HTTP and Web software interfaces such as JavaScript Object Notation (JSON) and networking orchestration tools such as OpenConfig and NETCONF have been crucial to enabling the development of software-based automation of networking infrastructure.

Infrastructure as code: Tools coming out of the cloud world, such as Kubernetes and HashiCorp's Terraform, are enabling network elements to be managed and orchestrated directly from within the code of an application. Network connectivity and orchestration can be built into the code of cloud applications. Integration of networking with infrastructure-as-code tools will be key to the success of MCN and hybrid cloud networking (HCN) efforts.

Software overlays: Networking software overlays, which can include secure tunneling technologies such as IPsec and Transport Layer Security (TLS), enable applications and networks to be segmented using software only, rather than requiring separate logical hardware-based networks. But overlays are sometimes just a Band-Aid. MCN will take this a step further by enabling deeper management, segmentation, security, and control of cloud networks using overlay and virtualization technologies.

NaaS and cloud onramps. Cloud NaaS as a concept is a growing solution for connecting networks in the middle mile – or to provide an express lane to a Cloud PoP, often referred to as a cloud onramp. As cloud infrastructure expands, NaaS implementations will grow in importance to connect infrastructure – for example, automatically connecting enterprise WANs and SD-WANs to cloud PoPs to provide specialized security services, or connecting disparate service-provider networks to the cloud or datacenter infrastructure and colocation facilities using Ethernet or DIA. This will present new opportunities for service providers as well as startups to build NaaS infrastructure to facilitate interconnections.

Survey Findings: MCN Drivers, Feature Needs, and ROI

The MCN trend is driven by the growing need to connect a more distributed IT infrastructure. Data, applications, and infrastructure now exist in many places – enterprise datacenters, edge, and cloud – and technologies such as AI and Kubernetes mean that applications will become more distributed over time. Managers of this infrastructure will require more visibility and control of these sprawling connections. At the same time, organizations are using more partnerships in infrastructure, often using NaaS services provided by service providers, datacenter providers, and cloud providers to build a global virtual infrastructure.

As one cloud architect (anonymous) recently told us: “Multicloud is here to stay. When we are doing acquisitions and we can't choose which cloud they use, the only way we can function is a multicloud environment, with MCN. We can troubleshoot [the network] in minutes.”

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- Cloud Architect

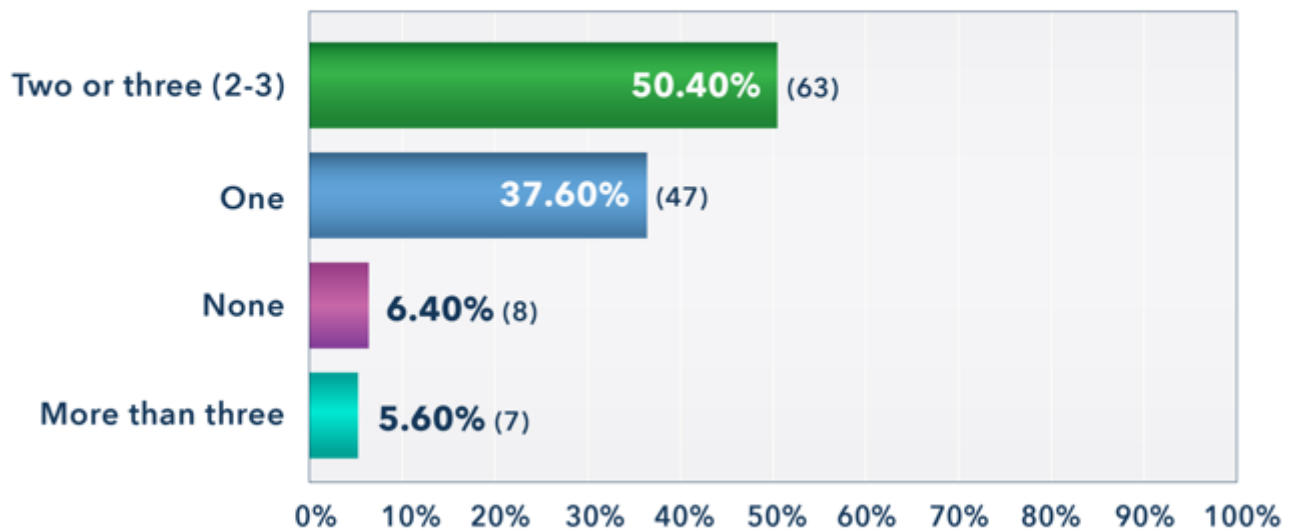
Meanwhile, AI is taking off, accelerating the need for data consumption and analytics, which will require persistent connectivity among infrastructure elements and applications. For example, organizations might want to connect edge infrastructure to AI services in the cloud or to an enterprise datacenter.

Our survey results reflect a broad need for responsive and automated MCNs that respond to these needs to provide connectivity for distributed applications, which require resources in many different types of compute, storage, and networking domains. Let's now take a detailed look at the survey results and what they mean.

Strong Need to Connect Multiple Clouds

In our MCN survey, when we asked about cloud providers for PaaS or IaaS, the bulk of respondents said they were using more than one provider, with 50% saying they were using 2-3 cloud infrastructure providers and 6% saying they were using more, meaning that 56% were managing a hybrid or multicloud environment.

How many public cloud infrastructure services (Platform as a Service or Infrastructure as a Service) are you currently using?



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Responses: **125**

The challenge in connecting public cloud services is that the major public cloud providers all have distinct and often proprietary networks inside of their clouds. MCN software and services are built to understand the connectivity particulars of each public cloud and provide connection points or gateways inside of the clouds that can enable network operators to gain better control and integration when connecting to multiple public clouds.

MCN Also Seen as Key to Delivering Hybrid and Application Strategies

Although many enterprises are using public cloud, recent trends indicate a shift back to private infrastructure in concert with public cloud services – a trend known as hybrid cloud. In our study of recent cloud deployments there are several leading reasons for this:

- Concerns about public cloud costs are driving enterprises to investigate how to leverage private

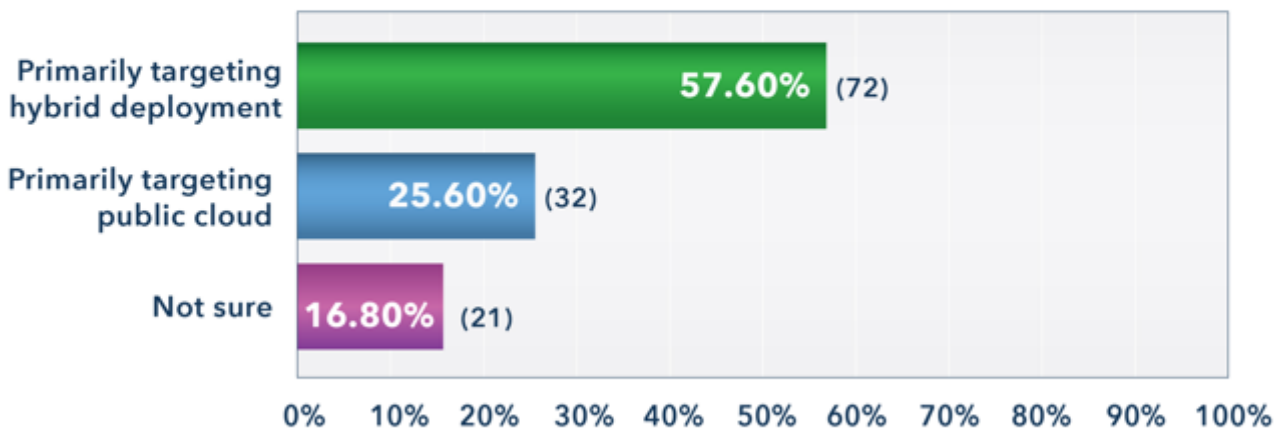
infrastructure or traditional enterprise resources.

- Distributed applications as well as data sovereignty demands often favor deployments on private infrastructure.
- Distributed apps sometimes require a more flexible hybrid infrastructure that is connected to both public cloud and private infrastructure.

Futurium’s own primary research shows a growth of hybrid cloud initiatives developing in the real world. In our regular interviews and surveys, it’s become clear that multicloud and hybrid are the wave of the future. For example, data from our own Cloud Tracker Pro services shows a groundswell in hybrid cloud activity among large global companies including AstraZeneca, BMW, BP, Deutsche Bank, Fidelity, Morningstar, Salesforce, and many others.

Survey data reinforces this notion. When we asked respondents where they were focusing their energies, 58% said they were primarily targeting hybrid deployments, while 26% were primarily targeting public cloud. Many are yet undecided, with 17% saying they weren’t sure.

Does your enterprise have plans for a hybrid deployment (continued investments in on-prem datacenter combined with cloud), or are you planning to migrate most on-prem workloads to the public cloud?



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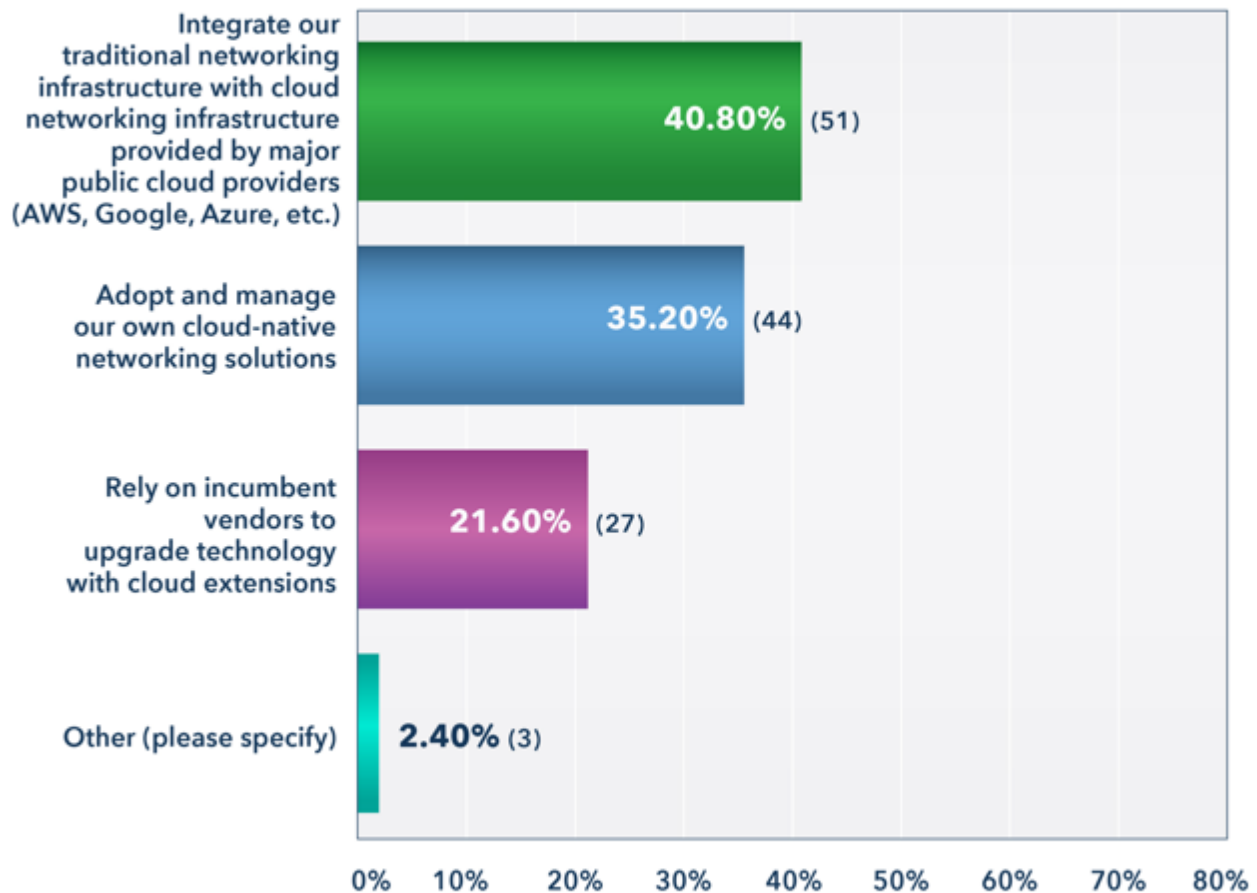
Responses: **125**

Favored Approaches to MCN and NaaS

As we’ve explained, MCN is about providing a quicker way to connect IT resources and services, including those hosted on public cloud and private infrastructure.

We asked survey respondents to describe their goals in deploying cloud networking technology. This question only allowed one selection to identify a top priority. There was a balance of selections across the options. The top goals included building cloud-native networking technology that is integrated with cloud provider constructs and connectivity models (selected by 38%), preserving investing by extending legacy networking technology into the cloud (30%), and increasing the using of public cloud networking infrastructure by building out overlays (23%).

What is your strategy to integrate datacenter networking fabrics with public cloud services?

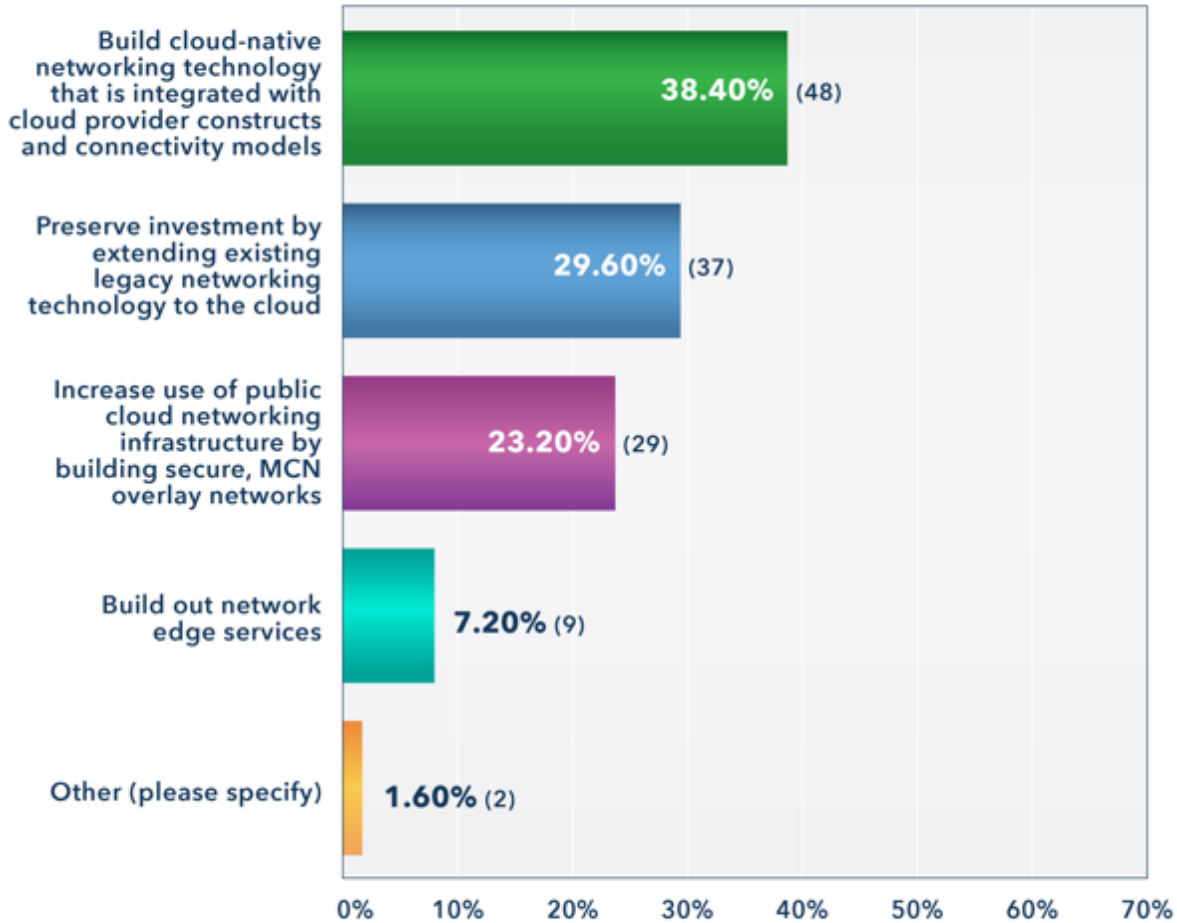


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As we mentioned earlier, SD-WAN was an early form of MCN, enabling branches and enterprises to more quickly connect to other services. As MCN broadens, it will be used to connect to any infrastructure as one logical network. We asked a question to determine some of the top strategies for connecting diverse infrastructure. You can see those results below.

What is the most important cloud networking initiative for the next 2-3 years?



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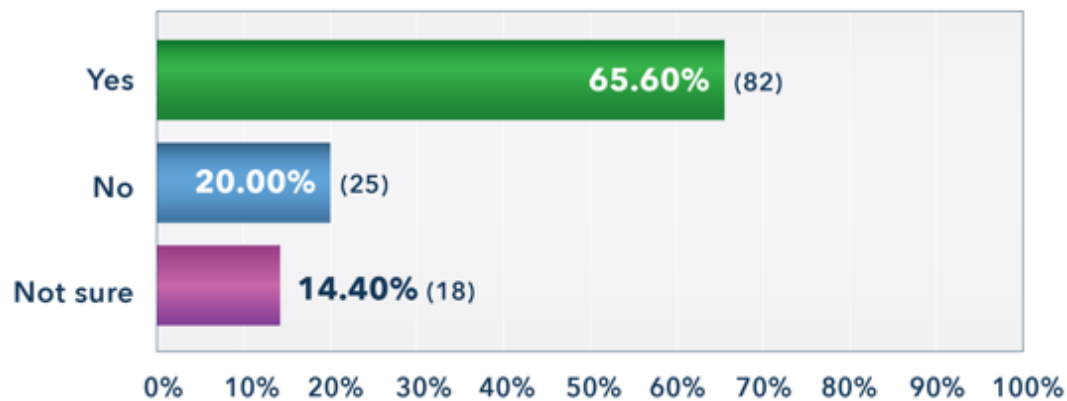
For the question above question, we asked for a single response to isolate the top strategies. The results indicates that two approaches are the most popular: The majority of respondents are pursuing a strategy focused on integrating enterprise network connectivity to multiple public clouds (41%) or adopting and managing their own cloud-native networking solutions (35%). Relying on incumbent vendors to upgrade technology with cloud extensions was further down the list (22%). This is one of the reasons we think the market is favoring startups for innovative MCN solutions.

MCN as a Key Enabler of Edge Applications and 5G

In addition to delivering integration among datacenters and public cloud services, MCN is also playing an important role in connecting edge services to service provider networks. One of the largest needs is for 5G and other edge connectivity services including private wireless.

When the survey audience was asked about whether new services such as edge compute, 5G, and private wireless would increase the need for MCN, 66% said yes.

Do you expect the arrival of new services such as 5G networks, edge compute, and private wireless connectivity to increase your need for multicloud networking (MCN) solutions?



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Responses: **125**

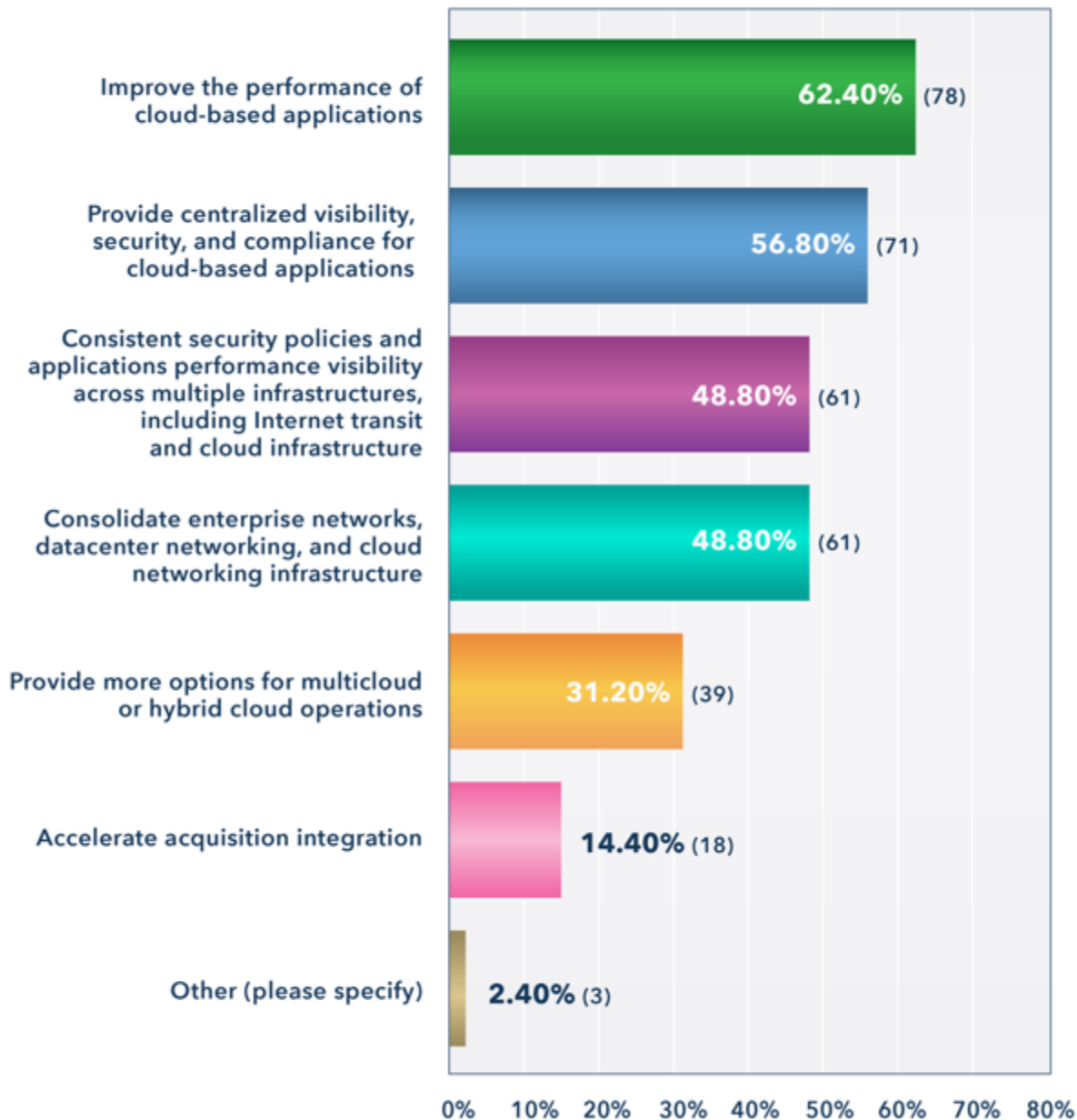
NaaS and MCN products that help enterprises and operators connect disparate cloud networks are expected to grow into the billions of dollars of revenue annually, according to Futuriom research. Some of these services will include features such as cloud-based routing and networking, direct connectivity to cloud PoPs, and management of cloud-based security and applications performance.

In addition, the explosion of AI will put new demands on connectivity at the edge, to enable the gathering, processing, and exchange of data from devices and edge compute installations.

Top Drivers: App Performance, Visibility and Security, and Network Consolidation

MCN technology has many potential benefits, including security, faster applications connectivity, better management, policy management, compliance, and cost management. To identify top-level drivers of MCN, we allowed multiple responses. You can see the results below.

What are the top drivers for building multicloud networking (MCN)? *(Select all that apply.)*



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Responses: **125**

As you can see, the drivers are well balanced and include a mixture of needs for improving the performance of cloud-based applications (62%); providing centralized security, visibility, and compliance (57%); providing consistent application policy and visibility (49%); and consolidating networking among various types of infrastructure (49%).

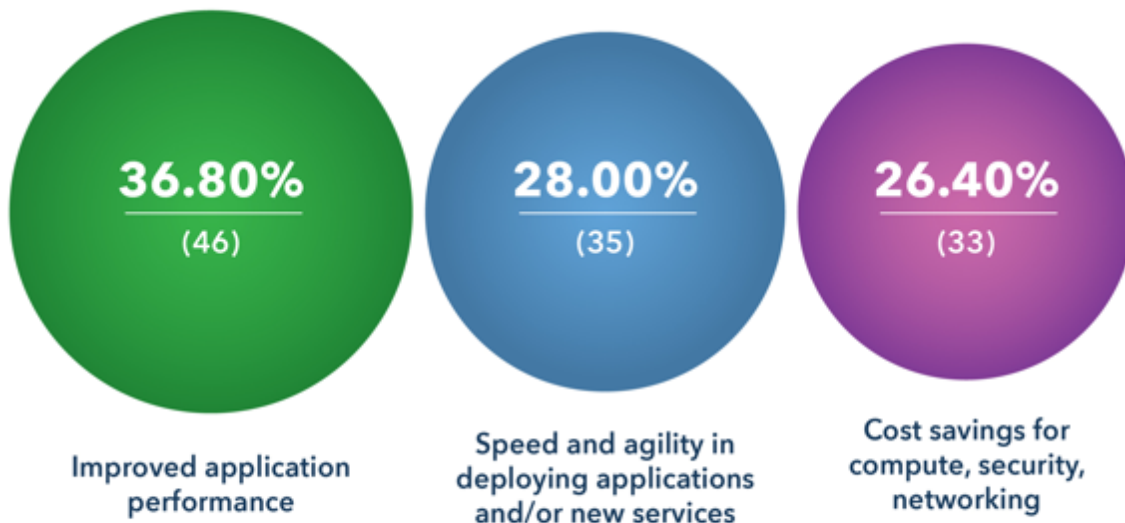
ROI Goals for MCN Are Diverse

The survey results have expressed several key themes for MCN: End users would like to connect and manage connectivity among disparate infrastructure, as well as improve security and improve application performance.

MCN technology can provide many subsets of specific features to help connect, manage, and secure the networks. Leading services and features we have identified include security features, visibility features, application policy features, and cloud cost-control features.

Ultimately, the users of MCN technology want an ROI. We have identified many opportunities for ROI for MCN. Below, we identified the top three – which include improved applications performance, speed and agility for deploying applications/services, and cost savings.

What is the most important ROI (Return on Investment) metric used to evaluate your success in cloud investment? (Pick one)



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Responses: **125**

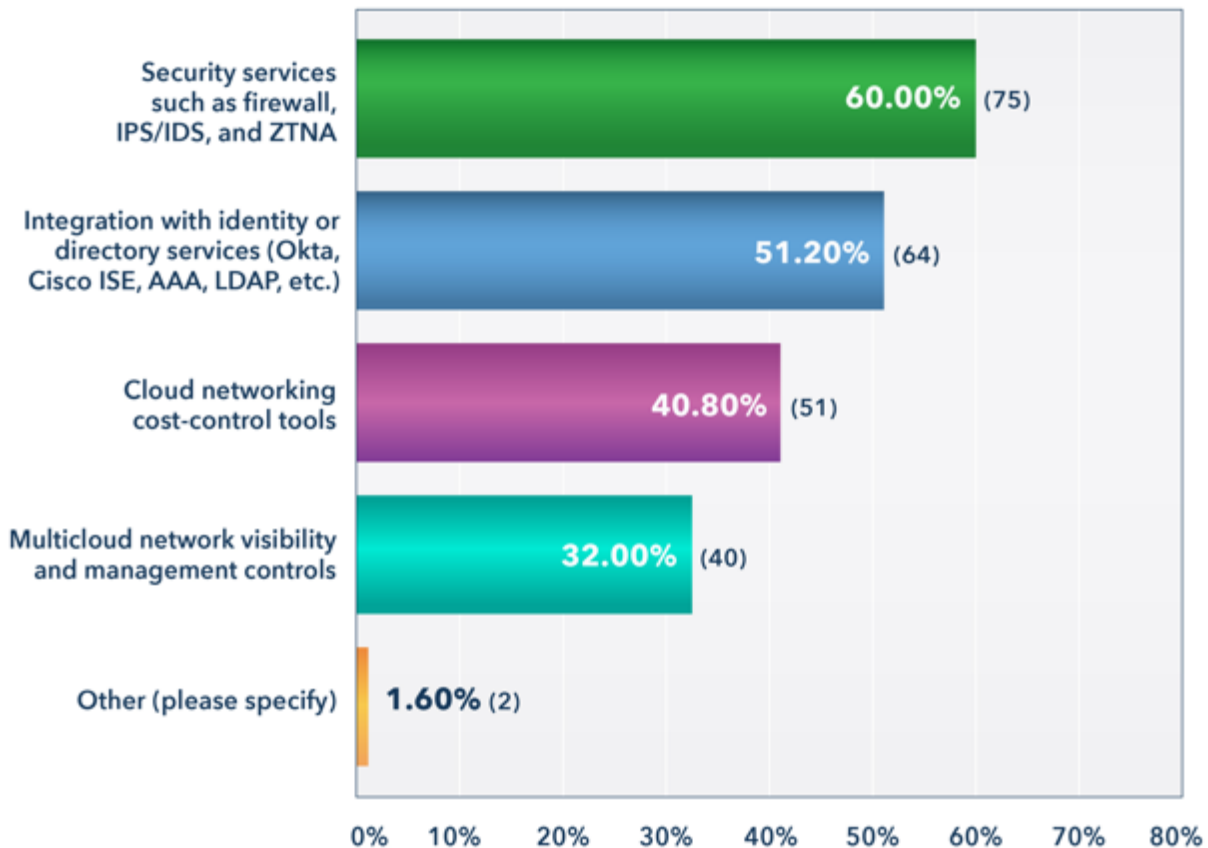
Security Features in Demand

As we have identified, key drivers of MCN include providing connectivity among public cloud constructs, enabling a secure networking overlay among various infrastructure components and

providing central visibility and policy for applications. But MCN can provide much more than that – including security, management, and cost-control features.

Two of the largest areas of feature demand are security and cloud cost control. Let’s take a look at the details of these two areas. First, security: MCN technology is becoming increasingly integrated with networking security, as you can see by the functions that are expected below.

Besides overlay connectivity, what other services do you want the MCN solution to provide?
(Choose the top two)



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In the results above, you can see that the features in high demand include security services (60%), directory integration (51%), and cloud networking and cost-control tools (41%). Multicloud network visibility and management controls also shouldn’t be counted out, with 32% identifying that area as a key service (multiple responses were allowed).

In the 2022 survey – which also allowed multiple responses – the key services and features selected included integration with identity or directory services (65%); security services such as

firewall, IDS/IDP, and ZTNA (53%); multicloud network visibility and management controls (44%); and cloud networking cost-control tools (42%). Security and cost-control tools remain the focus of those looking at MCN solutions.

Key Cost-Control Features

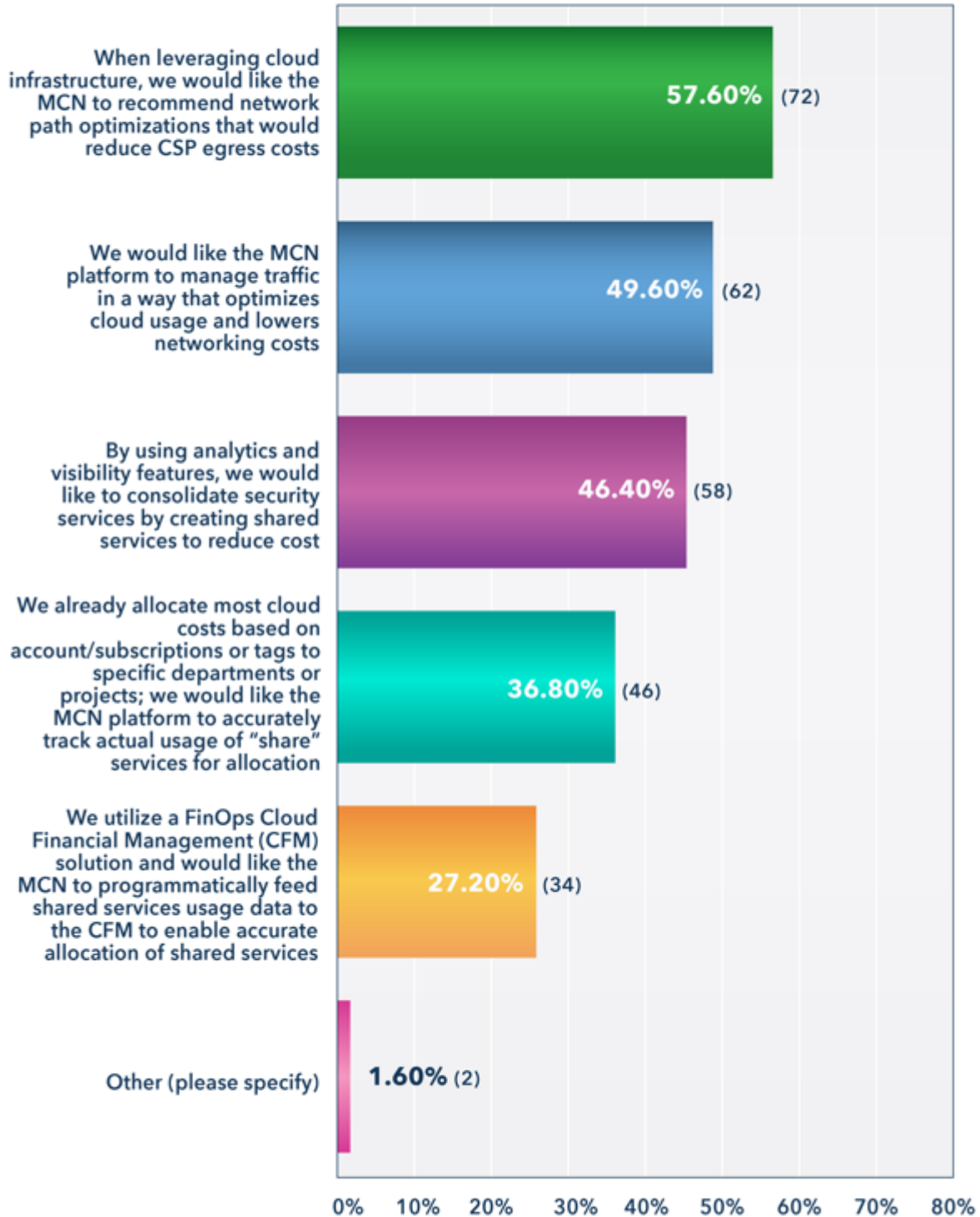
Because managing cloud costs are a hot area, we asked a question to drill down into the specific features and use cases of cloud cost control that might be needed. These results are presented on the following page. The features and approaches are diverse – including managing network path optimization (58%); optimizing cloud usage and network costs (50%); using analytics and visibility to consolidate security services to reduce cost (46%); tracking cloud services allocations (37%); and helping integrate with FinOps (27%).

These results were similar to the 2022 results, but the top two picks traded places. In 2022, the top features were optimizing cloud usage and network costs (61%); managing network path optimization (58%); using analytics and visibility to consolidate security services to reduce cost (51%); tracking cloud services allocations (32%); and helping integrate with FinOps (23%). One takeaway from the shift is that tracking cloud allocations and FinOps integration appear to be rising in interest.

These results indicate strong demand for many different types of features that could be enabled by MCN to help reduce costs. This reflects the ongoing evolution of the Financial Operations (FinOps) movement to reduce IT and cloud costs overall.

The full results can be seen on the next page.

What are some of the features and use cases you would like to see in multicloud networking (MCN) to manage cloud costs? *(Pick three)*



The MCN Landscape: Ecosystem, Startups, and Partnerships

As we have demonstrated, MCN is seen as a new platform to streamline network infrastructure; provide useful new features for managing cloud networking, security and cost controls; and help enable hybrid cloud applications and deployment.

The question you might have is: What types of technology, services, and partnerships will be needed to deliver this functionality? The networking ecosystem includes a wide range of equipment and software OEMs, public communications network providers (telcos), public cloud providers, and colocation providers. These technology and service providers are involved in the building of MCN. In many cases, building MCNs will require an integration of enabling technology and services.

Stakeholders in the MCN Ecosystem

In general, MCN platforms are being combined with networking services such as NaaS to abstract out network complexities and deliver the functionality we have discussed. Partnerships are being struck among technology providers, service providers, and cloud infrastructure providers to deliver this functionality.

Here are some of the providers in the MCN ecosystem working toward this goal:

MCN and networking technology providers (startups): There is a significant group of startups being funded in the venture community to help solve broad and complex MCN and HCN challenges. Futuriom believes that the MCN challenges are large – and therefore the market is large. Some of the key vendors to watch include Alkira, Aviatrix, Arrcus, Graphiant, Itential, Prosimo, and Versa Networks. More details on some of these companies are included below.

MCN technology providers (incumbents): Incumbent networking and cloud software providers will continue to add functionality to their existing platforms to enable MCN. In some cases, these functions will be built organically. Futuriom sees incumbents continuing down the path of M&A to buy innovation. Key vendors to watch for M&A include Arista, Cisco, HPE, IBM, Juniper, and VMware.

Telecommunications service providers: Telcos see the opportunity for MCN and hybrid cloud services, and once again they are trying not to be relegated to “dumb pipe” designation. Their opportunity lies in taking their global networking resources and integrating with cloud services and

next-generation MCN provisioning tools to make it easier for customers to leverage cloud networks. Companies and products to watch include Tata Communications, which has built its IZO Cloud Command product to help organizations integrate connectivity to multiple clouds over a single, secure private network with service level agreements (SLAs). SD-WAN service providers such as Aryaka Networks are also playing a key role in delivering MCN functionality by providing a bridge between enterprise and cloud networks.

Cloud PaaS and IaaS providers increase their presence at the edge. The largest cloud operators -- including Amazon, Google, Microsoft, IBM, and Oracle -- have built large cloud networks that can be used by enterprises to build MCNs. By establishing a global network of PoPs that can be accessed by APIs, PaaS and IaaS operators can provide MCN connection points closer to the enterprise customer. In some cases, the cloud providers aim to be MCN providers themselves -- by providing edge services that can be used by enterprises. Some examples include Google Cloud Anthos, AWS Regions and Zones, and Microsoft Azure Virtual WAN. While these MCN functions are useful for customers building inter-cloud networks, many of the public cloud infrastructure services are proprietary in nature. Futuriom believes that most larger enterprises will find these services useful to connect their MCNs to the public cloud providers, but many enterprises will want more control over MCNs that they build themselves.

Content delivery networks (CDNs), cloud NaaS, and middle-mile services. NaaS and CDN providers, like the cloud providers, have their own global networks that can be used by enterprises to build and connect MCNs. In contrast to some of the startup vendors that supply do-it-yourself (DIY) tools for building MCNs, many of these providers supply a NaaS service that enables the enterprise to outsource global networking services, often positioned in the “middle mile” of the global network. Some of the providers of cloud-based NaaS, middle-mile, and CDN services include Alkira, Akamai, Aryaka Networks, Cato Networks, Cloudflare, Megaport, and PacketFabric.

Colocation providers: Datacenter and colocation providers such as Equinix and Digital Realty have private cloud infrastructure and networking connectivity services that can be used to build MCNs. Because datacenter PoPs are often located in the same colocation facilities of public cloud providers, these services can be used as a bridge to MCNs -- for example, by connecting local private resources directly to cloud services, an approach known as cloud onramps. Futuriom sees the colocation providers as playing a key role in MCN development. For example, the Equinix Cloud Exchange Fabric (ECX Fabric) provides software-defined network interconnection across a global infrastructure and public cloud PoPs. Digital Realty’s SX Fabric enables organizations to securely manage cloud networks and applications among PoPs. The large colocation and datacenter providers are likely to continue to make moves to enable more extensive cloud networking integration for customers.

Leading MCN Startups to Watch

The venture market provides a steady supply of innovation that can be scooped up by the larger incumbents in waves of M&A. The most recent example in networking was the SD-WAN market, where startups provided the bulk of innovation for efficiently connecting enterprise branch offices. This market is still undergoing years of consolidation. The larger incumbents scooped up dozens of SD-WAN providers. Some of the more obvious examples include Cisco buying Viptela (2017), VMware purchasing VeloCloud (2017), and HPE purchasing Silver Peak (2020).

Futuriom now sees the MCN startups playing a similar role but in a smaller. The key MCN platform plays so far are Arccus, Aviatrix, Graphiant, and Proximo. Other startups such as Itential are providing important integration and automation tools to the MCN market. NaaS providers such as Alkira, Megaport, and PacketFabric are providing key NaaS interconnectivity tools.

The bottom line: It's likely still early in the MCN and HCN game. But the established startups will have a big edge as we think the demand curve is starting to hit. Let's take a look at the MCN startups we believe will have the most impact over the next few years:

Aviatrix, founded in 2014, is one of the early pioneers in the MCN market, with a variety of solutions targeting the tough problems of MCN, including Network Address Translation (NAT), secure cloud networking, cloud cost management, and cloud infrastructure visibility. The company has publicly listed more Fortune 500 customers than any other MCN startup, and it is believed to be approaching \$100 million in annual recurring revenue. Some Aviatrix customers include Adobe, Aegeon, Chewy, Global Foods, and Raytheon. In June, Aviatrix named industry veteran Doug Merritt its new CEO. Merritt was well known for taking data analytics company Splunk from hundreds of millions to billions of dollars in revenue. Aviatrix's most recent product moves included the launch of the Distributed Cloud Firewall, which is designed to solve the problem of securing networks in the cloud and in traditional enterprise networking environments.

Arccus is a growing cloud networking startup that has focused on MCN networking use cases for large enterprises and service providers. Shekar Ayyar, formerly an executive at VMware, has guided the company into several big wins in both the enterprise and service provider space. Its cloud routing and visibility platform FlexMCN is a flexible multicloud networking solution designed for large enterprises, CSPs, colocation providers, and telcos to seamlessly extend their on-prem networks to multicloud environments and to deliver multicloud connectivity as a managed service to enterprises. FlexMCN is in demand from enterprises, service providers, and webscale operators to help scale and connect edge networks, including 5G and private wireless. Arccus in September announced a collaboration with Red Hat, making Arccus FlexMCN a certified Red Hat OpenShift platform to help extend multicloud networking capabilities for service providers. This adds to the VMware certification for telco cloud. Arccus has raised total funding of about \$140 million.

F5 is a publicly traded company, rather than a startup, but its solution for multicloud networking is based on the technology derived from their acquisition of the startup **Volterra** in 2021. F5 integrated Volterra into its new Distributed Cloud Services portfolio to provide a distributed cloud networking platform to securely connect apps and Kubernetes services across cloud and edge environments. Distributed Cloud Network Connect and Distributed Cloud App Connect are SaaS-based services that connect, secure, and manage apps and networks deployed in hybrid and multicloud environments.

Graphiant is focused on the challenge of connecting multicloud deployments and partners that use edge services using its own "stateless core" technology. The Graphiant Network Edge is a NaaS solution providing connectivity for enterprise WAN, hybrid cloud, network edge, customers, and partners. It allows customers and partners to connect using a secure private NaaS that can be provisioned on demand. CEO Khalid Raza is the former co-founder of SD-WAN pioneer Viptela (sold to Cisco in 2017) and an ex-distinguished engineer at Cisco. The company has raised a total of \$96 million from investors including Two Bear Capital, Sequoia Capital, Atlantic Bridge, Harpoon Venture Capital Partners.

Itential is a network integration platform that can play a key role in MCNs by providing low-code and no-code integrations (for example, using APIs) to connect networking technologies in diverse domains such as enterprise, service provider, and SD-WAN. With Itential's automation platform, operators can operationalize and automate complex network configuration and networking tasks. The NetDevOps approach is key to bridging the gaps in multicloud environments. Led by CEO Ian Bresnahan, Itential has raised a total of \$30 million in funding from Elsewhere Partners and Tech Square Ventures.

Prosimo is led by former Vipela VP of Product Ramesh Prabakaran, who is CEO and cofounder. The Prosimo Full Stack Cloud Transit provides orchestration of cloud networking services, zero-trust security, and network monitoring and visibility features that can span multicloud and hybrid cloud environments. Looking to help accelerate the MCN market, Prosimo in June created a free version of its software, called MCN Foundation, which simplifies the setup of cross-cloud network services and access policies. It can also discover cloud assets and help with real-time network troubleshooting. The company has raised a total of \$55 million through Series B from a variety of investors including General Catalyst, WRVI Capital, Redline Capital, and Nepenthe Capital.

Versa Networks helps simplify the complexities of disparate cloud environments while securing users, apps, and data. Delivered as a unified experience with inline controls, the Versa Unified SASE platform bridges the gaps between cloud-native tools across different vendors by facilitating advanced networking, consistent policy enforcement, automation and optimized connectivity across clouds for the seamless, efficient, and secure multicloud experience. Versa Networks has

raised a total of \$312 million from Sequoia Capital, Mayfield, Artis Ventures, Verizon Ventures, Comcast Ventures, Liberty Global Ventures, Princeville Global Fund, and RPS Ventures. CEO Kelly Ahuja, a former Cisco executive, recently told Futuriom that Versa has raised enough money to get it to cash-flow positive or IPO, which is expected in the next year.

Traditional Networking: Watch for More MCN M&A

So far, Futuriom has expected that MCN functionality will be driven by innovation in the startup market, which it has been. This is because traditional networking incumbents, including Arista Networks, Cisco, Nokia, and Juniper Networks, are still largely focused on enterprise and datacenter hardware. In addition, they are more incentivized to keep captive networking user bases focused on their own products, rather than making it easier to build networks using cloud services and infrastructure.

In addition, it has proven difficult for incumbents put together an MCN platform with all of the functionality needed to cross the different segments needed for a full cloud networking solution – for example SD-WAN, SASE, zero trust, visibility, etc. Most of the incumbents have acquired technology in each of these areas. They are likely to do the same and pursue M&A for MCN technology.

Our survey results and conversations with end users indicate that MCN is considered a new platform that is likely to challenge and even displace traditional networking infrastructure over time. This is part of an overall business IT movement toward more flexible, cloud-based technology that doesn't require a high capital investment (capex). Incumbent vendors will have to migrate their strategies to a software-and-services story over time.

Let's go through the MCN strategies of some key incumbents.

VMware has a large portfolio with many of the components of MCN, although this functionality is still somewhat isolated in different groups. For example, at VMware Explore in Las Vegas in August, VMware announced NSX+, a cloud-managed service designed to enable consistent network and security operations, centralized security policy management, network and application visibility, and network detection and response across cloud networks. In addition, VMware's VeloCloud SASE and SD-WAN platform has expanded capabilities to connect to multicloud PoPs. Also in August, VMware announced the VMware Edge managed connectivity service enabling wireless service providers to deliver private 4G/5G services to enterprises. VMware Edge Cloud Orchestrator provides unified management for VMware SASE and the VMware Edge Compute Stack.

Cisco's MCN strategy hinges on the use of a combination of its Cisco Application Policy Infrastructure Controller (APIC) and Nexus Dashboard Orchestrator (NDO). APIC is the single point

of policy configuration and management for all the Cisco ACI switches deployed in the datacenter. NDO is a software solution that can be used as a single point of policy orchestration and visibility across multiple geographically dispersed ACI sites, with capabilities to connect to cloud services such as AWS, Microsoft Azure, and Google Cloud. That covers the datacenter – but what about the corporate branch and edge? Cisco is still digesting many of its enterprise and SD-WAN acquisitions, including Viptela and Meraki. It has many operating systems – too many, in our opinion – which prevents integration for MCN. We note that our end-user survey data shows a need for a centralized networking platform that can provide one point to deliver visibility, security, and governance. Integration of its sprawling portfolio of hardware and software solutions has proven to be a challenge.

HPE is in a similar position to Cisco with lots of enterprise campus networking technology, but it has done more to integrate its Aruba edge products, which now are merging security functions such as SASE with the Silver Peak SD-WAN product line. It has yet to express a specific MCN strategy, in our opinion.

Juniper, likewise, has an SD-WAN and SASE portfolio as well as firewalls and full networking capabilities, so it's a natural fit for MCN, but it does not specifically market MCN functionality. Juniper has been evolving its network automation story with its Mist AI and Apstra platforms, but so far this functionality has been focused on enterprise and datacenter networks rather than multicloud capabilities.

IBM has a full portfolio of cloud management products, including Red Hat, and has been developing a strategy for multicloud – though networking is not yet a core element. IBM Cloud Satellite, for example, uses an API to create a distributed cloud location, then add host machines from any cloud, on-premises datacenter, or from the edge.

SD-WAN, SASE, and MCN Convergence Continues

We have pointed out that the SD-WAN market was successful because it used SDN technologies along with commodity off the shelf (COTS) hardware to help enterprises more economically deploy, network, and manage branch-office connections and endpoints, using a cloud-hosted services model. The expansion of SD-WAN into the SASE market was an extension of that – providing an expanded portfolio of network security services, available either from the cloud or on the network edge.

Because MCN is part of a larger trend of the virtualization and abstraction of networking services, it makes sense that MCN is evolving in a similar way to the SASE and SD-WAN markets, which aimed to virtualize connectivity and deliver new cloud-based networking services. We have already seen evidence of this as incumbent networking vendors such as VMware, Juniper, and HPE/Aruba

expand and integrate edge SASE services with enterprise networking.

Enterprise networking provider Extreme Networks has moved to a single cloud-based networking management system that can control many networking domains, including campus wireless and enterprise branches.

The cloud providers are extending their network services to the enterprise edge while the networking providers are looking to give enterprises more flexible platforms for connecting their networks to cloud services. In the middle mile, NaaS providers such as Aryaka Networks, Cato Networks, Cloudflare, and Megaport look to provide services that can bridge the gap between enterprise networks and cloud services. Even content delivery networks have looked to get in the game by expanding security and NaaS with their global networks of PoPs.

Finally, you see networking technology companies focused on security – such as Versa Networks – moving into the MCN market, while companies that had previously focused on MCN – such as Aviatrix – are adopting more security features, such as Aviatrix Distributed Firewall capabilities.

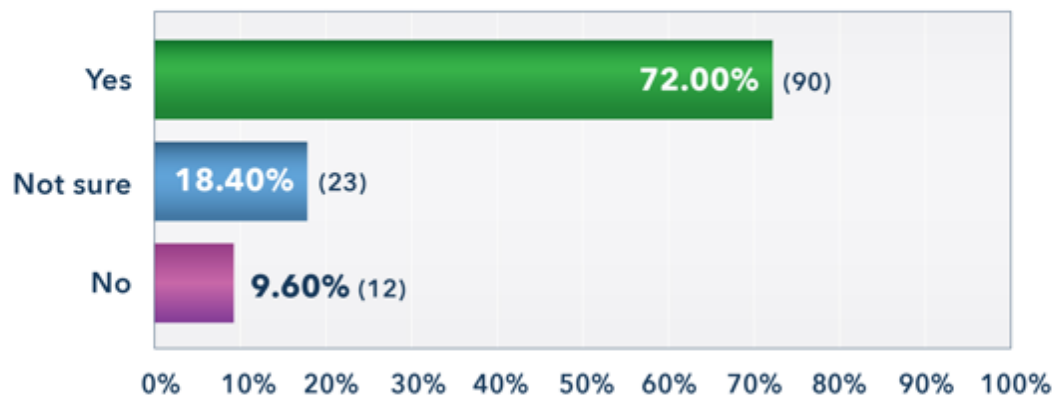
In our discussions with both end users and technology vendors, it's clear that SD-WAN and MCN enter the same discussion when network managers and IT professionals are looking to upgrade their infrastructure to adapt to cloud environments. Over time, we expect to see increased overlap and integration among the technologies, just as we have seen at the edge with virtualized networking and security technologies buckets such as ZTNA and SASE.

Conclusion: MCN Will Be a Strategic Driver of Hybrid and Multicloud Efforts

The data from our survey, now in its fourth year, has established a consistent number of trends for cloud networking infrastructure. Networking operators are keenly interested in using MCN tools and services to advance several goals – including integrating their networks with many different types of cloud services; gaining better network visibility and security; managing cloud and infrastructure costs; and driving into new hybrid cloud applications and infrastructure.

One overall conclusion is that network operators of all sorts don't want a fragmented collection of networks, they want to see one logical network. This means they would like to use MCN tools and services to build one abstracted, logical network to connect their end users, applications, and services. By building logical MCNs, they can gain better overall security, visibility, and governance of all networking infrastructure – as seen in the survey results below.

Do you believe that building abstracted multicloud networking (MCN) can help improve overall security, visibility, and governance of your networking infrastructure?

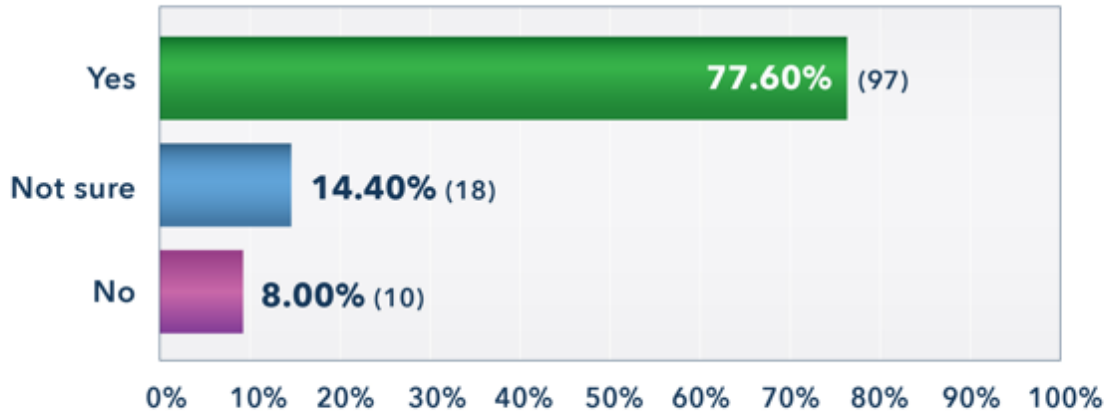


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Responses: **125**

The other key conclusion of this year's survey is that MCN is seen as a strategic technology to support the growing demand for hybrid cloud architectures. MCNs will be key enablers of hybrid and multicloud environments. As seen in the survey results below, the majority (78%) believe MCN will help simplify or accelerate hybrid cloud and multicloud adoption.

Will multicloud networking (MCN) help simplify or accelerate hybrid or multicloud adoption?



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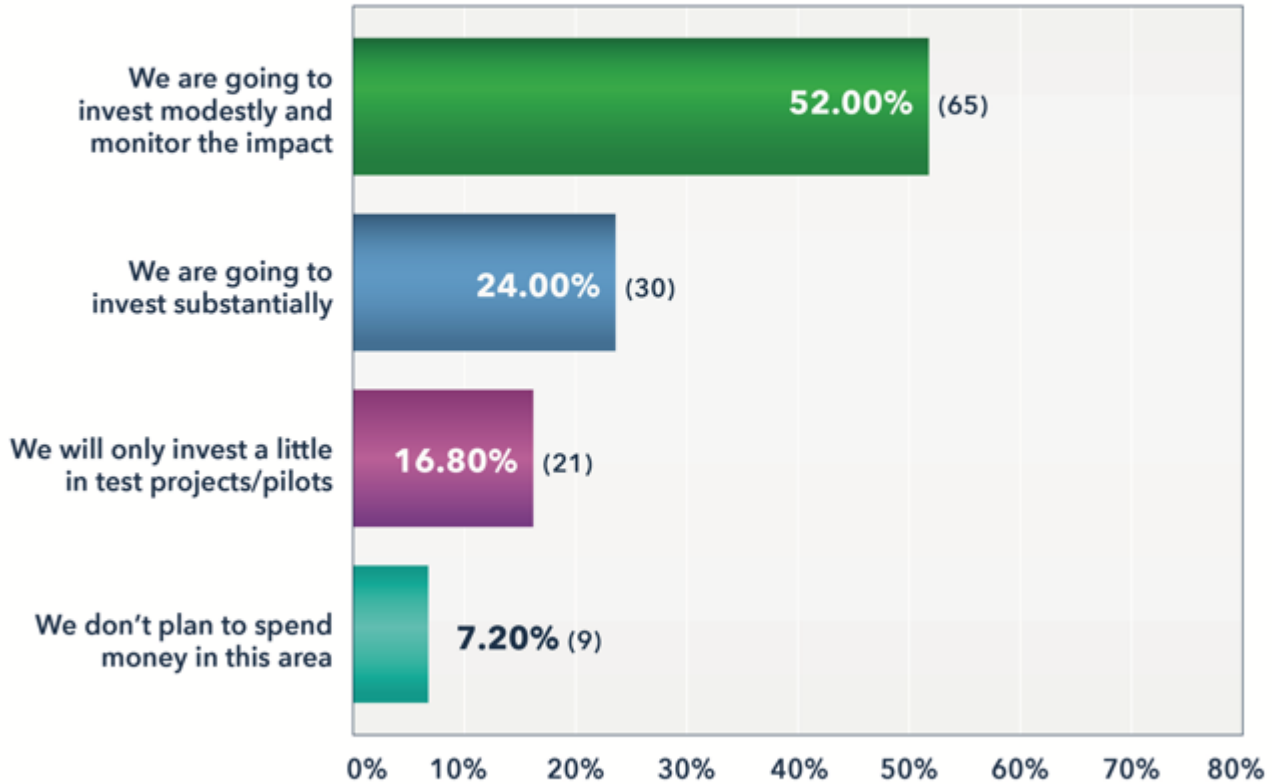
Responses: **125**

The survey respondents see strong potential for return on investment (ROI) in MCN, driving the need for more investment. It can help network operators streamline operations, reduce costs, and consolidate security operations. This is reflected in our question asking about investment.

Of those surveyed, 24% expect to invest substantially in MCN and cloud-native networking technology over the next 1-5 years, and 52% expect to invest modestly and monitor the impact – meaning a combined 76% are expecting modest or significant investment. Only 17% said they would invest “a little,” and 7% said they don’t plan to invest in this area.

(Results on the next page.)

What is your expectation for investing in MCN and cloud-native networking solutions over the next 1-5 years ?



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Responses: **125**

This expectation of investment shows that the Third Wave of Networking – MCN – is at a critical stage of evolution as organizations look to their networking technology to enable fully distributed apps that can leverage all forms of infrastructure in the cloud, datacenter, enterprise, and communications landscape.